The Nucleon Spin Puzzle

~0.6 from EJ-sum rule
~0.2 from DIS
"spin crisis"

RHIC Spin & SIDIS

DVCS

Spin Sum Rules

Longitudinal $1/2 = 1/2\ \Delta\Sigma + \Delta G + L_L$

Transverse $1/2 = 1/2\ \delta\Sigma + L_T$

~0.6 from Lattice QCD

No gluon

Sivers DF

"Recovery" of EJ-sum rule?

Collins FF from Belle

SI-DIS & **RHIC Spin**

BNL Spin Group / STAR spin :

ΔG : Jet/Pion/photon A_{LL} at wide rapidity range

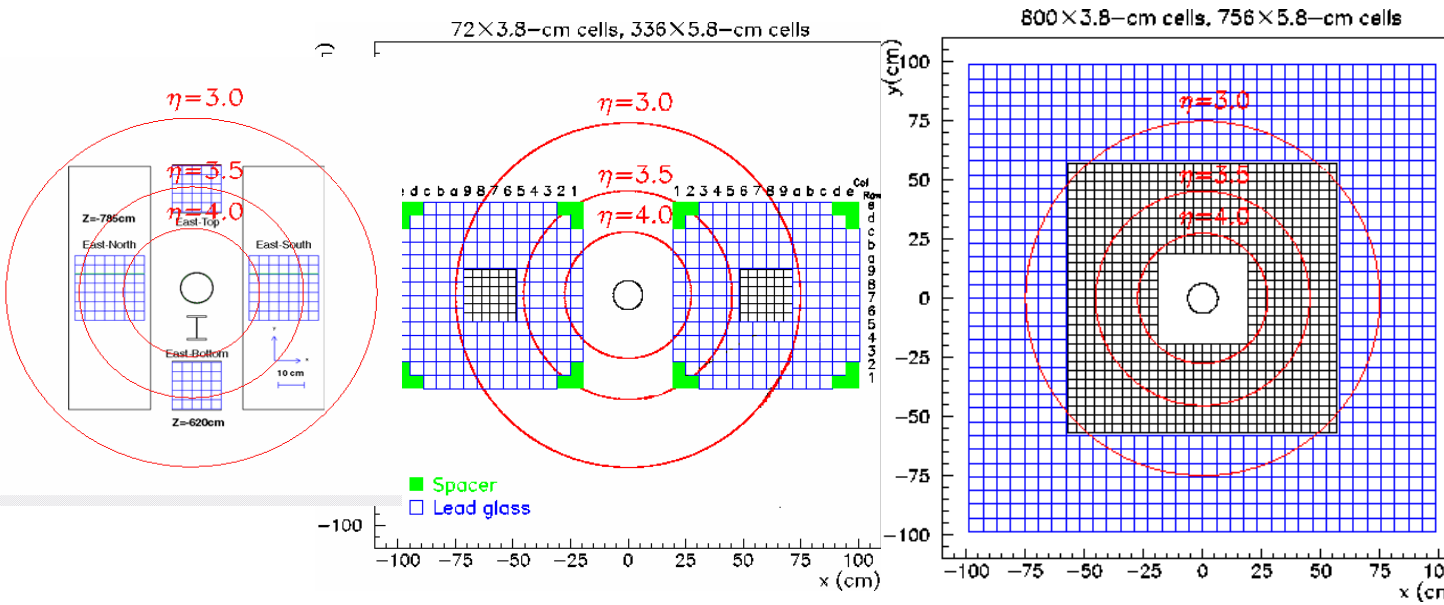
Transversity*CollinsFF : Belle (BRBC effort) + STAR "jet"

Sivers DF : "Jet"/Photon A_N, di-hadron/di-jets

Forward rapidity mostly detects **large-x valence quark** + **low-x gluon**

- **Large-x (long.) quark polarization is known to be large**
- **Directly couple to gluons = An ideal probe of low x gluons**

- STAR Beam-Beam Counter: Triggering. Luminosity measurements, Local Polarimetery
- STAR Forward Calorimetry: FPD (run3-5) → FPD++(run6) → FMS(run7)



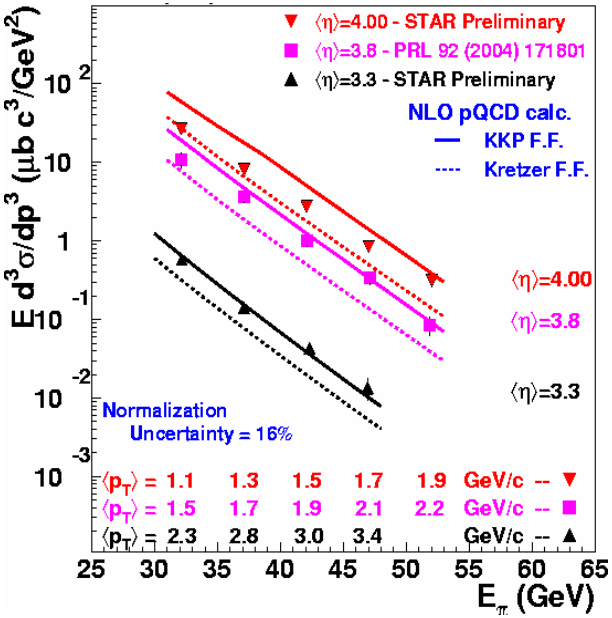
Large acceptance of FPD++/FMS enables :

- Direct photon
- “Jet like” events
- Di-hadron correlations
- Heavier mesons?

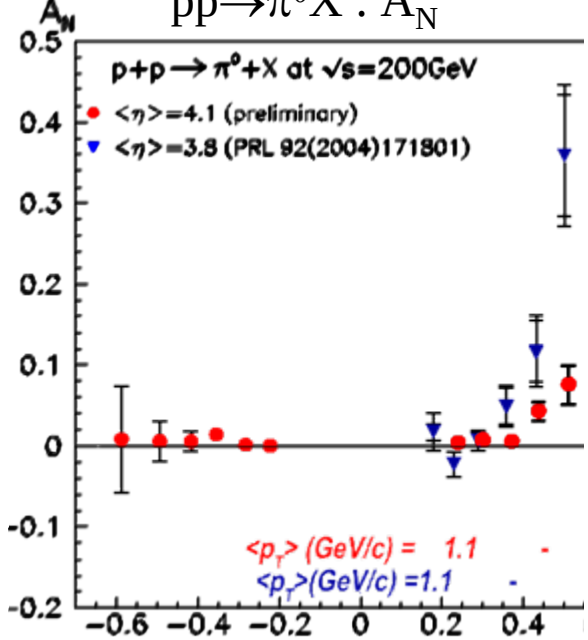
Results and Outlook

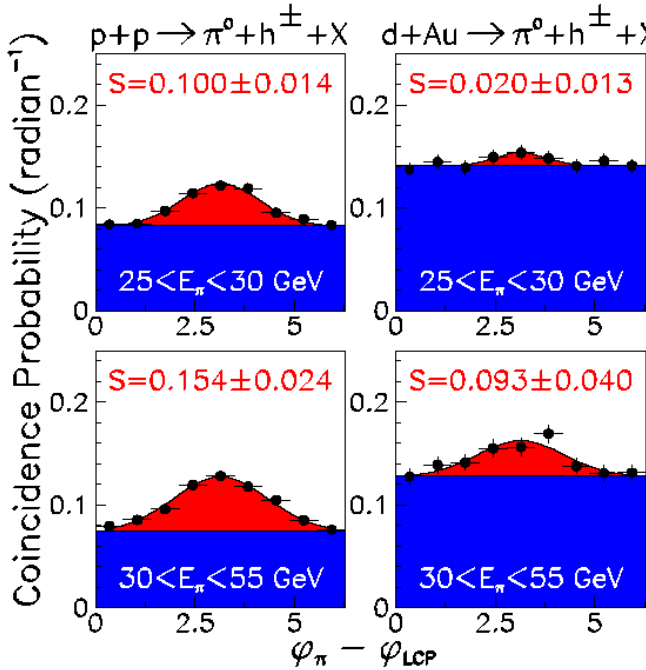
Phys. Rev. Lett. **92** (2004) 171801
nucl-ex/0602011

$pp \rightarrow \pi^0 X$: Cross Sections



$pp \rightarrow \pi^0 X$: A_N





$pp \rightarrow \pi^0 hX$ .vs. $dAu \rightarrow \pi^0 hX$

Established pQCD applicability for $pp \rightarrow \pi^0 X$ @ 200GeV
Sizable Transversity*CollinFF and/or Sivers DF
+ Belle result suggests large CollinFF
Suppression of π^0 production in d+Au @ forward rapidity → Possible gluon Saturation?

With larger acceptance of FPD++/FMS
→ A_N "jet like events"/photon → Direct Sivers DF measurements
A_{LL} photon → ΔG at low x
Di-hadron correlations → gluon density & beyond